# LEAD FRAME PLATING APPARATUS

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

The present invention relates to a lead frame plating apparatus, and more particularly to a lead frame plating apparatus, which is provided with nozzles, each having a shape for preventing the plating solution from generating a vortex flow, and induces mixing of the plating solution to uniformly distributing the plating solution into nozzles.

### 2. Description of the Related Art

A conventional lead frame plating apparatus will now be described with reference to the drawings.

Referring to Fig. 1, plating solution 3 supplied through a supply pipe 1 is driven by a pump 5 and is then supplied to a distribution part 10 defined with a predetermined space therein through a bottom part inlet 7.

As shown in Figs. 2 and 3, the conventional lead frame plating apparatus is provided with a plurality of distributing plates 12 inside the distribution part 10, in order to induce a uniform flow of the plating solution supplied from the bottom part inlet 7 to be guided into nozzles 14 at an upper portion of the apparatus.

Each distributing plate 12 is formed with a plurality of hollow portions 13, so that when the plating solution 3 passes through the hollow portions 13 of the distributing plates 12, the plating solution 3 is uniformly mixed.

Then, as shown in Fig. 1, the plating solution 3 is injected to an upper side through the nozzles 14, thereby performing a plating operation for a lead frame 17 which is restricted in its upward movement by a top part block 16.

Meanwhile, since the conventional lead frame plating apparatus is provided with a mask 19 under the lead frame 17, the plating solution 3 injected through the nozzles 14 arrives only on predetermined portions of the lead frame
17. Further, the plating solution 3, having fallen to a lower side, is guided to either side to flow along a passage defined at a lower portion of a guide plate 18.

In accordance with the conventional lead frame plating apparatus, the bottom part inlet 7 is provided at the center of a lower side of the distribution part 10, and three or more distributing plates 12 are used for the uniform distribution when the plating solution from the bottom part inlet 7 flows to the nozzles 14. With the conventional lead frame plating apparatus, when the plating solution 3 passes through the hollow portions 13 of the distributing plates 12, vortex flow is generated, causing a detrimental loss in pressure.

Thus, in order to supply the set amount of fluid required for plating, the plating solution supply pump 5 should be increased in capacity. Further, an increase of pressure for supplying the plating solution 3 raises the inner pressure of the distribution part 10, thereby increasing the possibility of breakage of the apparatus and reducing durability thereof.

Further, as shown in Figs. 4 and 5, the nozzles 14 are mounted such that with a plurality of nozzles mounted on the upper side of the distribution part 10, the plating solution 3 is injected to the upper side through each nozzle aperture 15 formed at each nozzle 15.

As described above, if the plating solution 3 is injected to the upper side through the conventional straight nozzles 14, the vortex flow of the plating solution 3 is generated, as shown in Fig. 6, near the inlet of each nozzle, causing a decrease in the width of the fluid passage of the plating solution 3. Thus, the quantity of plating solution is reduced, thereby decreasing the injection rate of the plating solution at the outlet of each nozzle.

## SUMMARY OF THE INVENTION

The present invention has been made to solve the above problems, and it is an object of the present invention to provide a lead frame plating apparatus, which supplies plating solution to nozzles with a uniform distribution and with a reduced pressure loss.

It is another object of the present invention to provide a lead frame plating apparatus, which overcomes the problem of increased cost due to the increased capacity of a supply pump for supplying plating solution compensating for the pressure loss occurring when the plating solution is mixed, and which prevents a breakage of the apparatus due to an increased inner pressure of the plating solution.

It is yet another object of the present invention to provide a lead frame plating apparatus, which prevents a decrease in the width of a fluid passage of the plating solution by removing vortex flow generated near the inlet of each nozzle, thereby increasing fluid quantity and flow rate of the plating solution injected from the nozzles.

In accordance with an aspect of the present invention, the above and other objects can be accomplished by the provision of a lead frame plating apparatus, comprising: side inlets provided in a diagonal direction at opposite sides of the lead frame plating apparatus, respectively, for supplying plating solution; a flow mixing room defined with an inner space in a longitudinal direction for the plating solutions, flowing in through side inlets, to be mixed with each other while flowing in parallel; a plating solution outlet for guiding the plating solution in the direction of the nozzles, the plating solution outlet having a cross-sectional area smaller than that of the flow mixing room; and a plating solution distribution part provided with the nozzles at an upper portion of the plating solution outlet, each nozzle being provided, at the lower end thereof, with a divergent-shaped expansion tube such that an inner diameter of the inlet of the expansion tube, larger than that of the nozzle, gradually decreases to the extent of the inner diameter of the nozzle.

In accordance with the present invention, an excessively large-capacity pump is not required due to the structure which reduces pressure loss during mixing the plating solution, so that cost reduction and prevention of breakage in the apparatus by an excessive inner pressure can be obtained, and so that when the plating solution passes through each nozzle, the vortex flow is not generated, thereby achieving a proper supply of the plating solution.

## BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a structural view showing the main construction of a conventional lead frame plating apparatus;

Fig. 2 is a front view of the conventional plating apparatus;

Fig. 3 is a partially cut-away perspective view of Fig. 2;

Fig. 4 is a perspective view illustrating the plating apparatus with nozzles mounted thereon;

Fig. 5 is a side sectional view of the plating apparatus of Fig. 4;

Fig. 6 is a diagram illustrating flow of plating solution passing through one of the nozzles;

Fig. 7 is a perspective view of a lead frame plating apparatus according to an embodiment of the present invention;

Fig. 8 is a partially cut-away perspective view of another embodiment of the plating apparatus;

Fig. 9 is a front view of the plating apparatus;

Fig. 10 is a plane view of the plating apparatus;

Fig. 11 is a right-side sectional view of the plating apparatus;

Fig. 12 is a partially cut-away perspective view of the plating apparatus;

Fig. 13 is a side sectional view of the plating apparatus;

Fig. 14 is a side sectional view of a plating apparatus according to another embodiment of the present invention;

Fig. 15 is a side sectional view of a plating apparatus according to yet another embodiment of the present invention; and

Fig. 16 is a diagram illustrating flow of plating solution passing through one of the nozzles according to the embodiment of the present invention.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Now, preferred embodiments of the present invention will be described in detail with reference to the annexed drawings. In the drawings, the same or similar elements are denoted by the same reference numerals even though they are depicted in different drawings.

As shown in Fig. 7, a lead frame plating apparatus of the present invention is provided with side inlets 20 for supplying plating solution at opposite sides of a flow mixing room 30 which has an oval-shaped cross section such that the plating solution, flowing in through each side inlet, is mixed while flowing in parallel.

As shown in Figs. 7 to 11, the side inlets 20 are provided at the opposite sides of the flow mixing room 30, respectively, in the diagonal direction such that flow of the plating solution from one of the side inlets 30 into the flow mixing room 30 is influenced as little as possible by the flow from the other side inlet 30.

The lead frame plating apparatus of the invention is provided with a plating solution outlet 40 having a rectangular-shaped cross section at an upper side of the side inlets 20, and a plating solution distribution part 60 provided with nozzles 70 at an upper side of the plating solution outlet 40 to inject the plating solution toward an upper part of the apparatus.

The plating solution outlet 40 of the structure as described above may be installed with one or two distributing plates 50 provided with a plurality of holes 51, as shown in Fig. 8.

Operation of the lead frame plating apparatus will be described hereinafter.

As shown in Figs. 7 to 12, when the plating solution flows into both sides of the flow mixing room 30 through the side inlets 20, the plating solution from each side inlet 20 flows in parallel and the kinetic energy of the flow changes into pressure to make the flow uniform.

A increased pressure on the plating solution in the flow mixing room 30 causes the plating solution to flow to the upper side through the plating solution outlet 40, so that the plating solution is injected to the upper part through the nozzles.

Since the flow of the plating solution from the side inlets 20 generates a relatively low pressure at the inlets but it generates a high pressure at the opposite side of the flow mixing room, the balance between the pressures is not maintained. In order to compensate for the imbalance between them, the side inlets 20 are located at opposite sides of the flow mixing room. Further, as shown in Fig. 10, the side inlets 20 are provided such that the flow of the plating solution from one of the side inlets 20 does not interfere with the flow from the other side inlet 20.

In accordance with another embodiment of the invention, as shown in Fig. 8, the plating solution outlet 40 is provided with one or two distributing plates 50. Thus, the plating solution mixed in the flow mixing room 30 while flowing therein is mixed again when passing through the distributing plates 50, so that the plating solution is more uniformly mixed.

As a result, compared with the conventional plating apparatus, the plating apparatus of the invention without or with a few distributing plates reduces the pressure loss of the flow due to the vortex flow generated when the plating solution passes through the distributing plates 50, and enhances durability of the lead frame plating apparatus due to a reduced pressure in the plating apparatus.

Further, as shown in Fig. 13, each nozzle 70 mounted to the distribution part 60 is provided with a first divergent-shaped expansion tube 80 at the lower end portion. The first expansion tube 80 is mounted by being

inserted into the distribution part 60.

The first expansion tube 80 has a divergent shape in which an inner diameter of the inlet of the first expansion tube 80, larger than that of each nozzle 70, gradually decreases to an extent of the inner diameter of each nozzle 70.

According to another embodiment of the invention, as shown in Fig. 14, each nozzle 70 is provided with a second divergent-shaped expansion tube 82 protruding from an outer side of the distribution part 60.

According to yet another embodiment of the invention, as shown in Fig. 15, a third divergent-shaped expansion tube 84 in each nozzle 70 has a protruded part, similar to that of the second tube 84 as shown in Fig. 14, on the outer side of the distribution part 60. However, the third expansion tube 84 has a tubular shape, whereas the second expansion tube 82 is shaped such that one end of the divergent shape adjoins to be fixed to the distribution part 60 at a predetermined thickness.

In addition to the above embodiments, various embodiments can be applicable within the spirit of the present invention wherein the lower end of each nozzle 70 has a divergent shape.

Operation of the nozzles 70 will now described.

When the plating solution, having flowed in through the supply pipe, flows into both sides of the flow mixing room 30 through each side inlet 20, the flow of the plating solution are in parallel with each other and the kinetic energies of the flows change into the pressure to make the flows uniform.

A raised pressure on the plating solution in the flow mixing room 30 causes the plating solution to flow to the upper side through the plating solution outlet 40. Then, the plating solution is uniformly mixed again to a predetermined extent inside the distribution part 60 and is injected to the upper part through the nozzle 70 mounted on the upper side of the distribution

part 60.

As shown in Fig. 16, the flow of the plating solution to the upper side through each nozzle 70 is defined such that the plating solution 90 flows from the expansion tube 80, 82 or 84, of which the diameter gradually decreases, to the upper part through each nozzle opening 72. Here, the shape of the expansion tube 80, 82, or 84 prevents the flow of the plating solution 90 from generating the vortex flow, thereby avoiding the fluid passage from narrowing. Thus, compared with the prior art, the flow rate and the fluid quantity of the plating solution are increased, so that the plating solution is properly supplied to the lead frame.

As is apparent from the description, in accordance with the present invention, there is an advantageous effect in that the plating solution is supplied with a uniform distribution and with a reduced loss of pressure, thereby enhancing plating efficiency.

Further, due to the structure maximally reducing the pressure loss when the plating solution is mixed, an excessively large capacity pump is not required, thereby reducing costs.

Further, since the plating solution in an excessive pressure for compensating the pressure loss is not required to be supplied to the apparatus, the breakage of the apparatus due to a raised inner pressure is prevented, thereby enhancing durability.

Further, the expansion tube of the nozzle prevents the plating solution passing through the nozzle from generating the vortex flow, so that the quantity of the plating solution and the flow rate are increased, thereby enhancing reliability.

It should be understood that the embodiments and the accompanying drawings as described above have been described for illustrative purposes and the present invention is limited by the following claims. Further, those skilled in the art will appreciate that various modifications, additions and

substitutions are allowed without departing from the scope and spirit of the invention as set forth in the accompanying claims.